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Fursa

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(54) **DEVICE ASSEMBLY METHOD AND DEVICE MANUFACTURED ACCORDING TO SUCH METHOD**

(71) Applicant: **Philip Morris Products S.A.**, Neuchatel (CH)

(72) Inventor: **Oleg Fursa**, Neuchatel (CH)

(73) Assignee: **Philip Morris Products S.A.**, Neuchatel (CH)

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(Continued)

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Primary Examiner — Gary F Paumen
(74) *Attorney, Agent, or Firm* — Oblon, McClelland, Maier & Neustadt, L.L.P.

(57) **ABSTRACT**

An aerosol-generating system is provided, including: an aerosol-generating device configured to heat an aerosol-forming substrate; and an exterior sleeve, the device including a device housing and a plurality of internal components contained within an interior space enclosed by the housing, the housing including an external surface and at least one bent or bendable portion, bent or bendable into or towards the interior space to interact with one of the internal components, and the exterior sleeve covering the at least one bent or bendable portion. A kit including the aerosol-gen-
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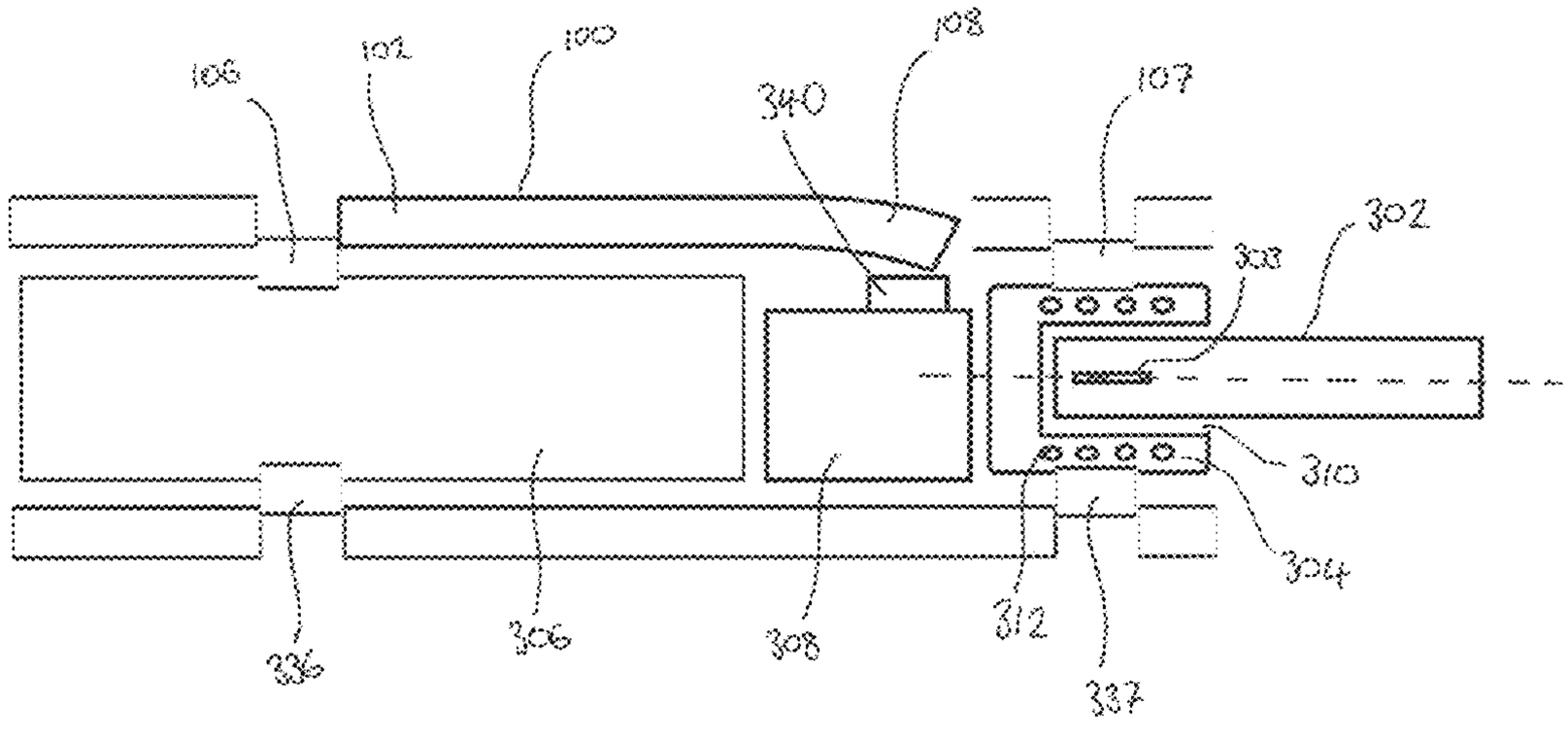

erating device and at least one exterior sleeve, and a method of manufacturing an aerosol-generating system, are also provided.

15 Claims, 8 Drawing Sheets

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A24F 40/51 (2020.01)
A24F 40/60 (2020.01)
A24F 40/70 (2020.01)

(58) **Field of Classification Search**
USPC 131/329
See application file for complete search history.

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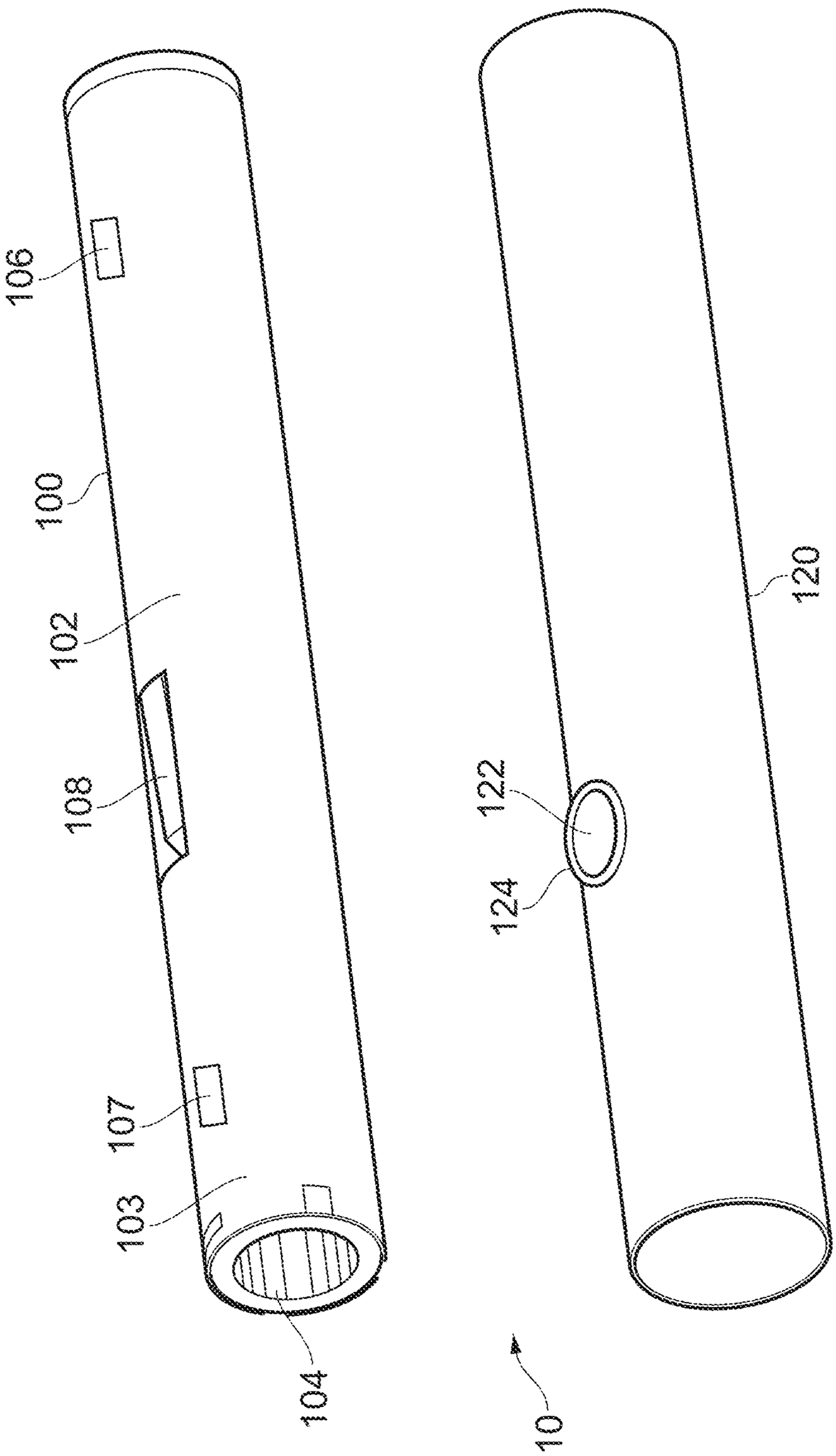
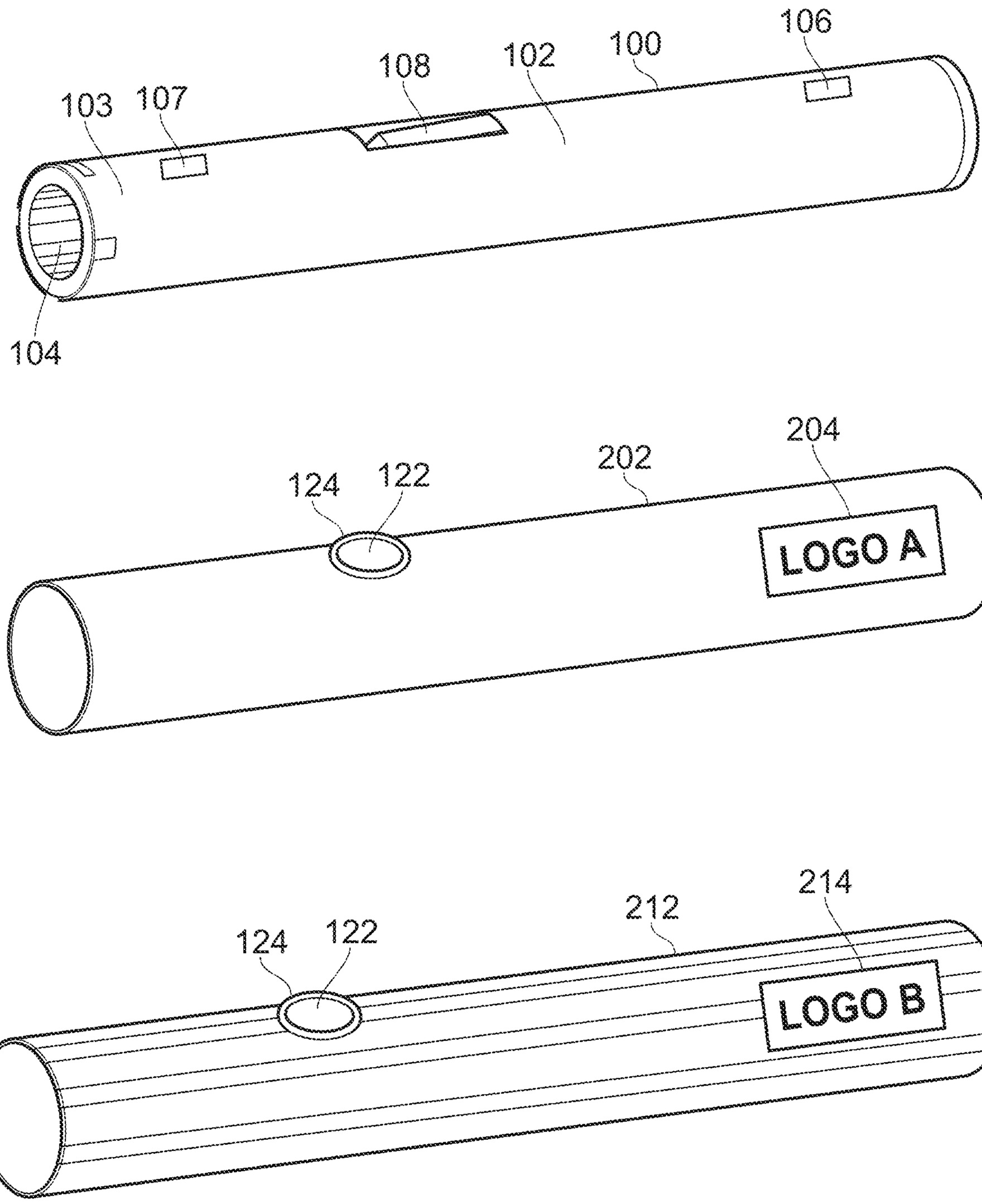


FIG. 1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LOGO A
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LOGO B

FIG. 2

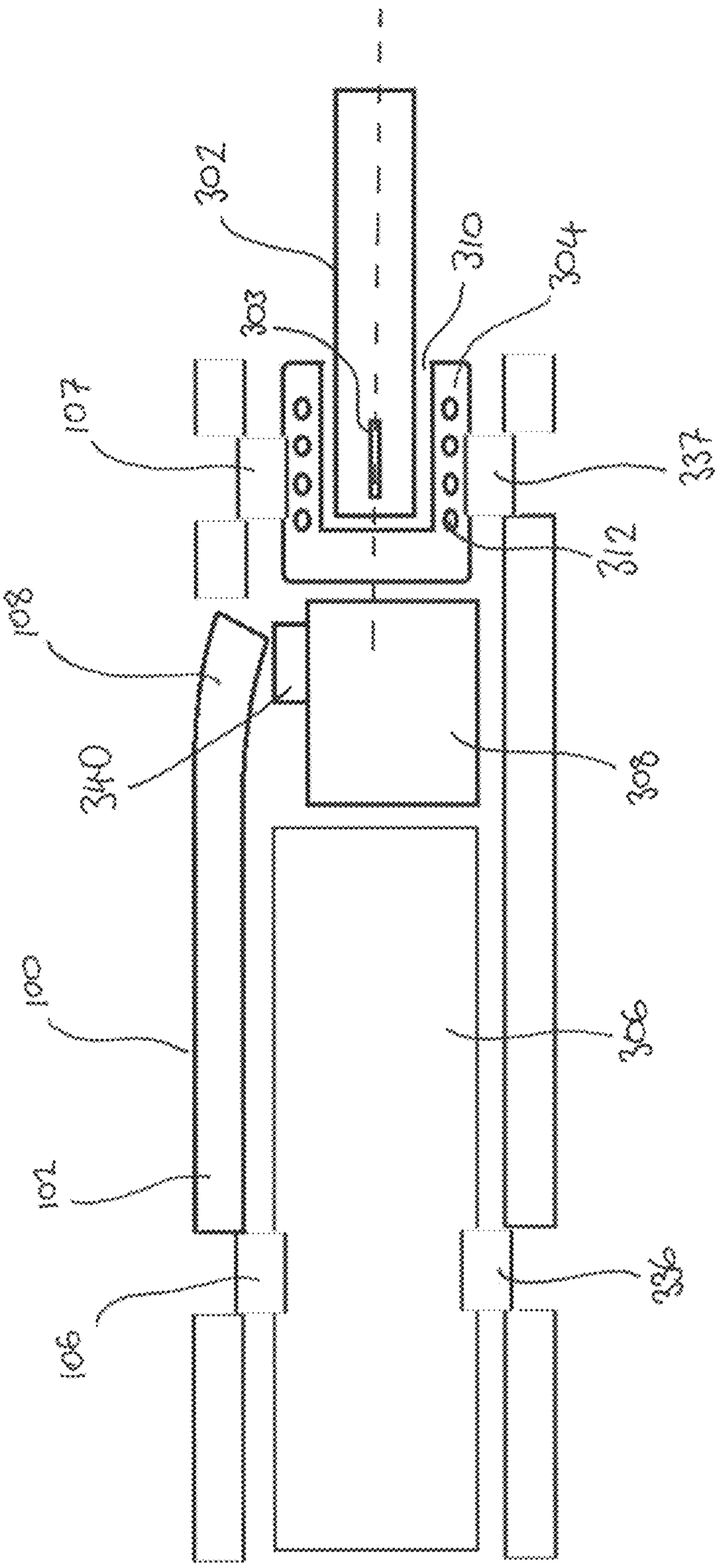

FIG. 3

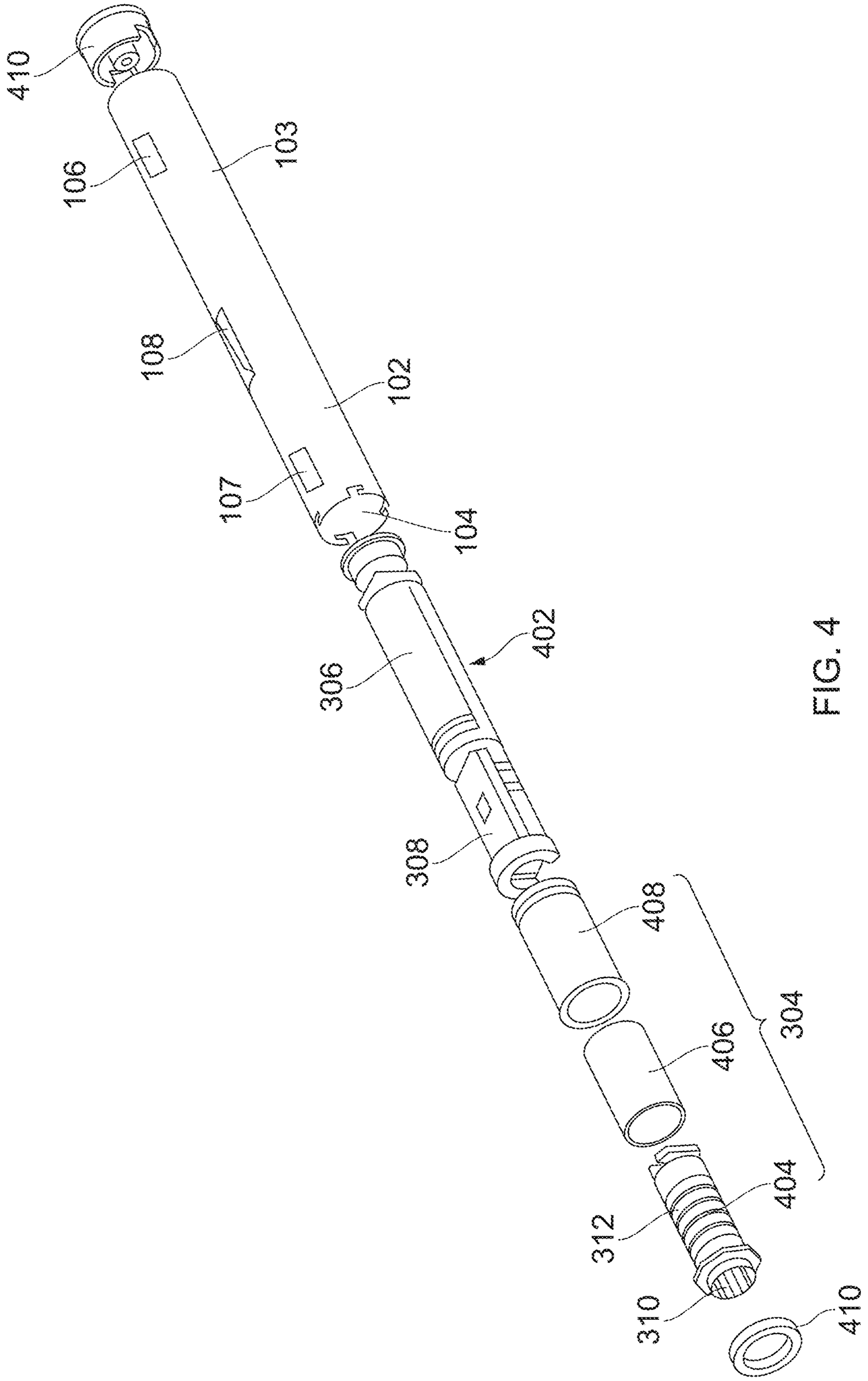
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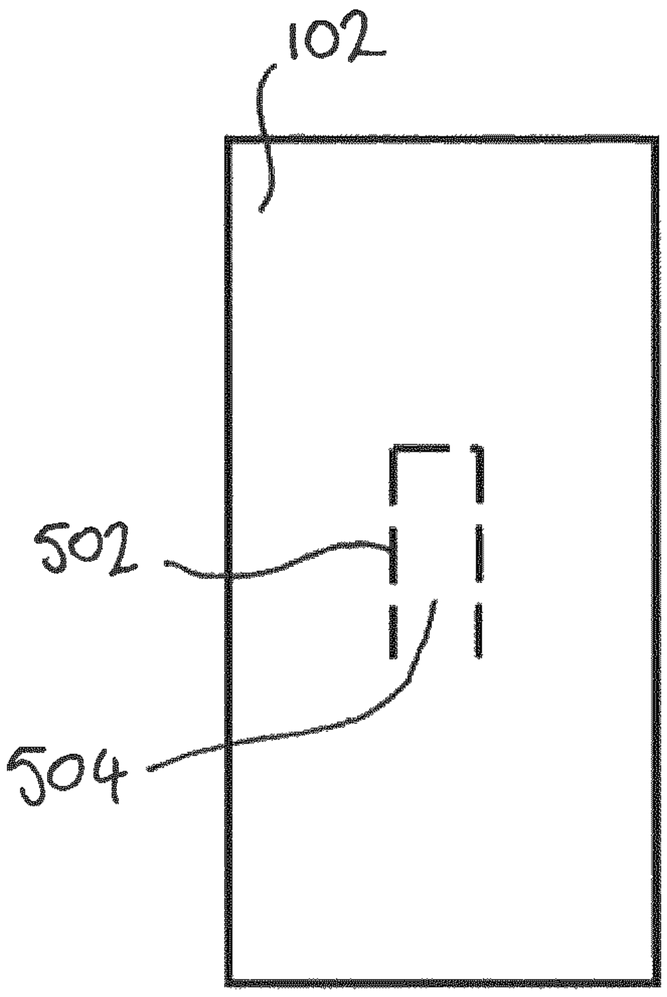
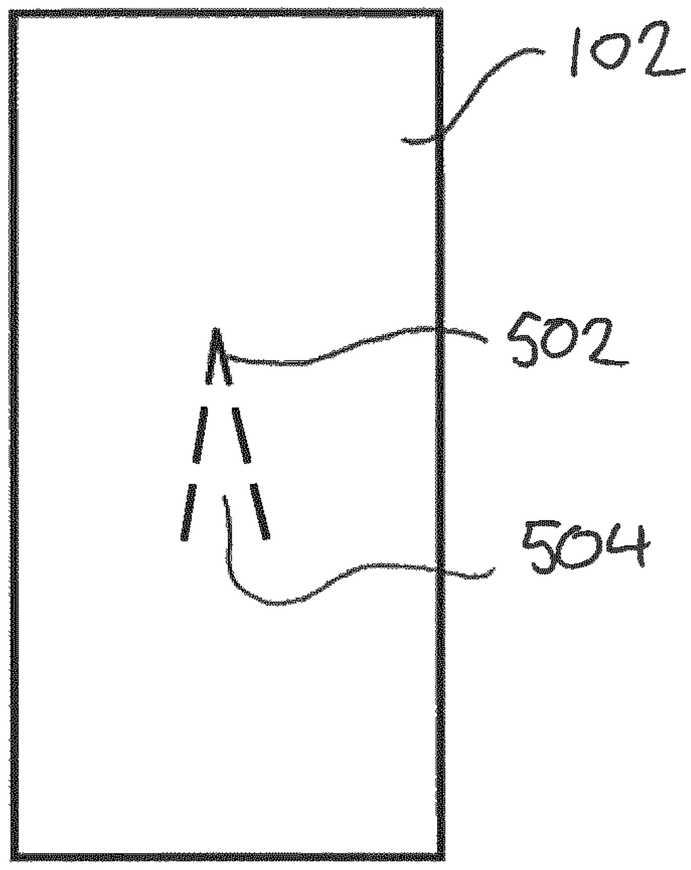
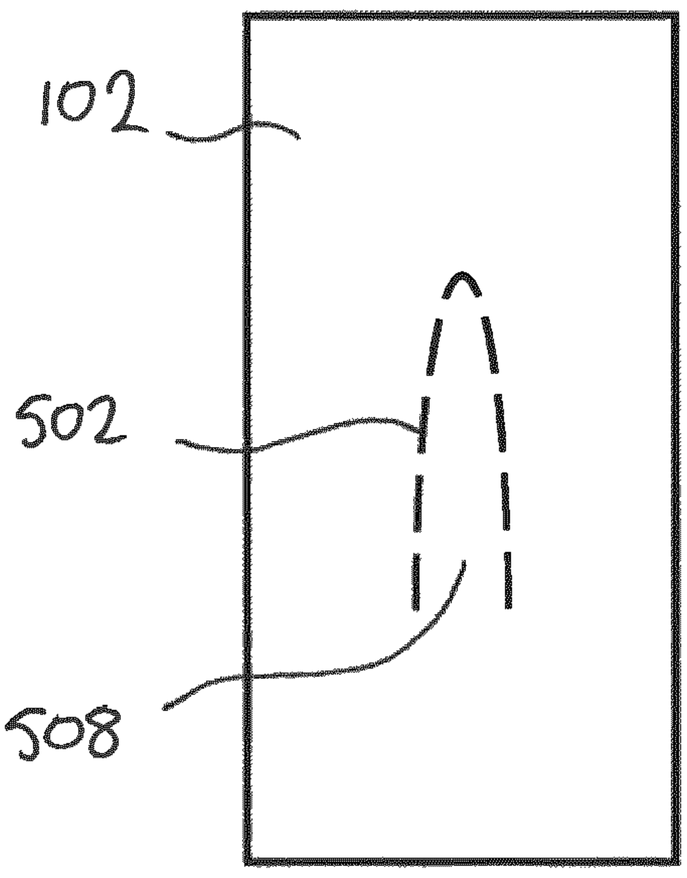
FIG. 4



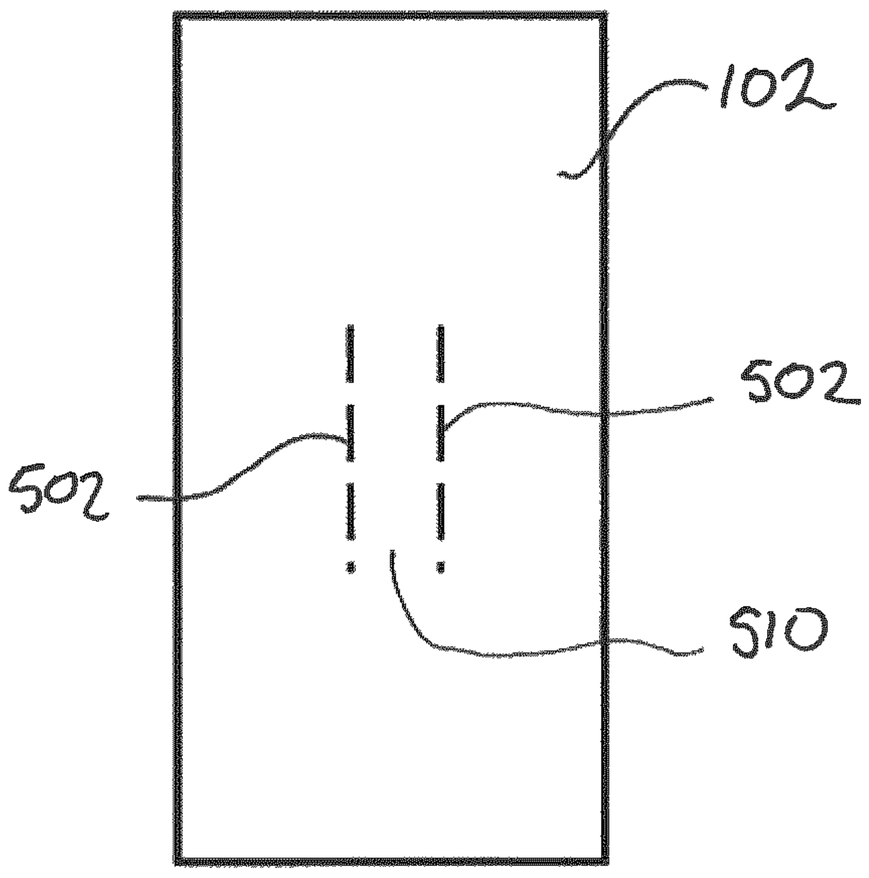
(a)



(b)



(c)



(d)

Figure 5

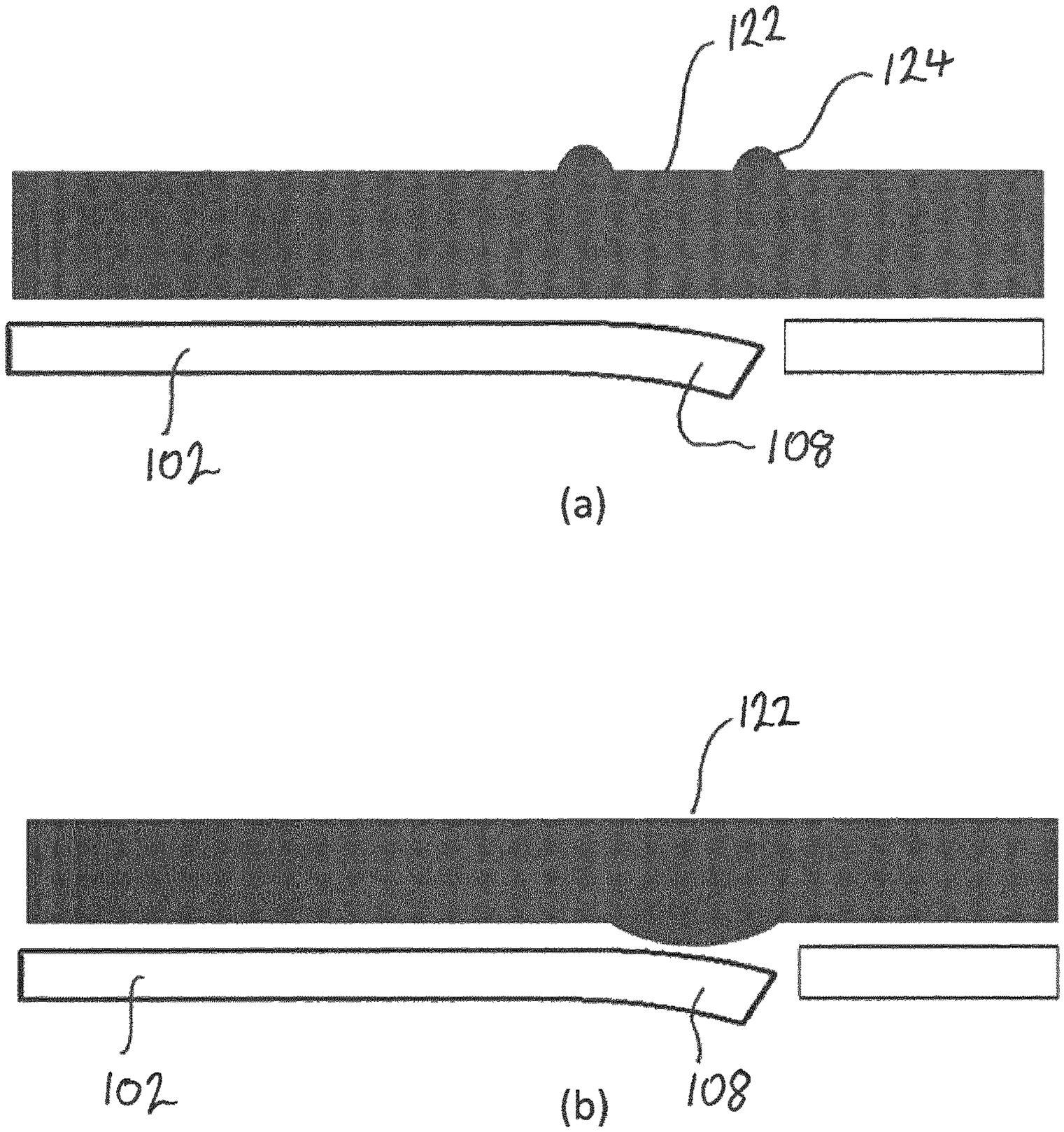


Figure 6

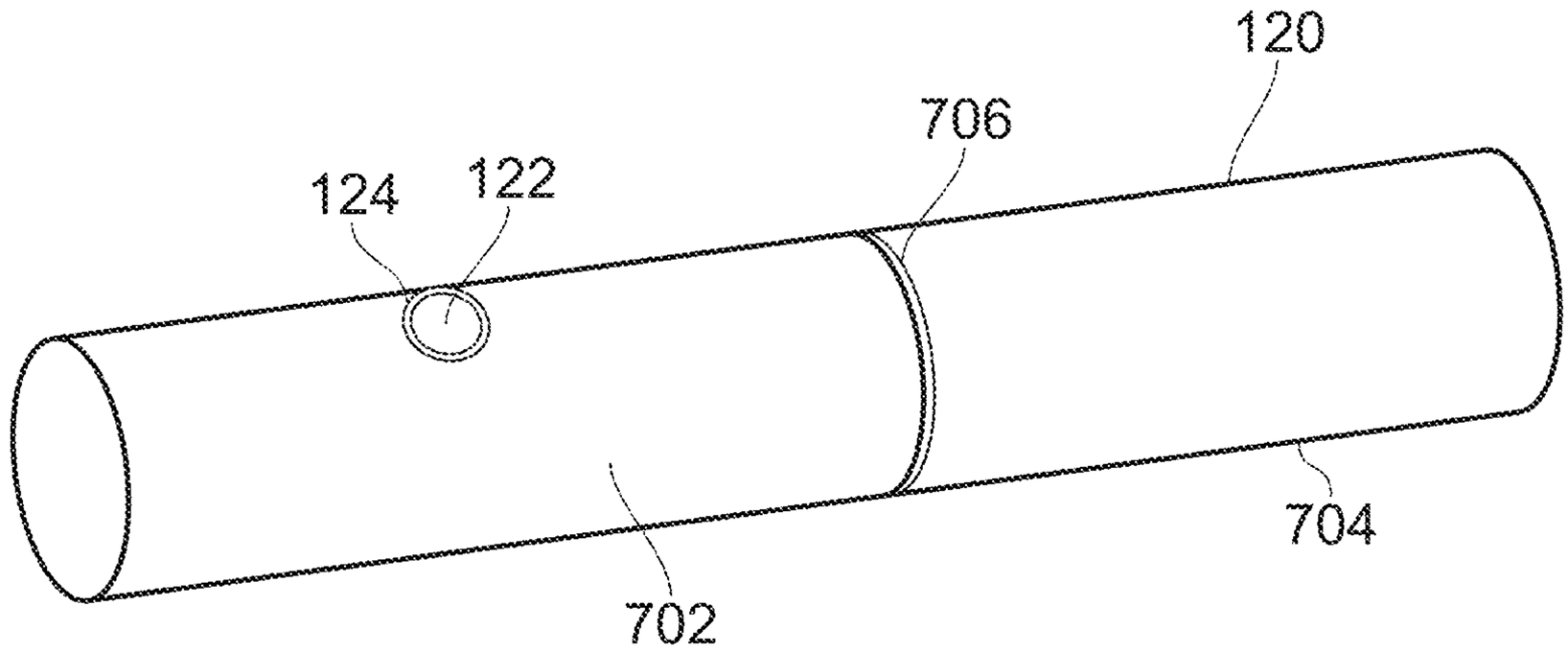


FIG. 7

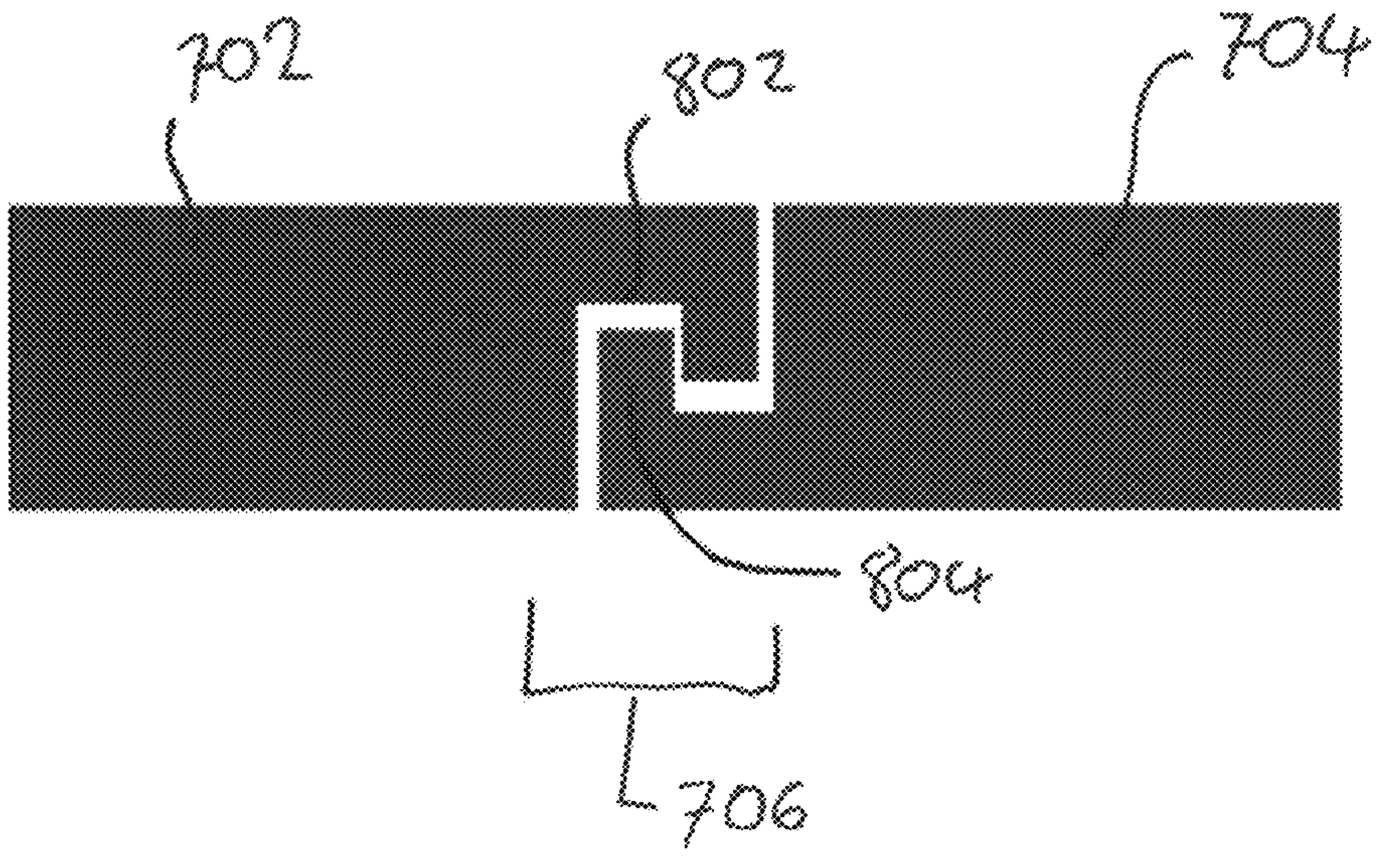


FIG. 8

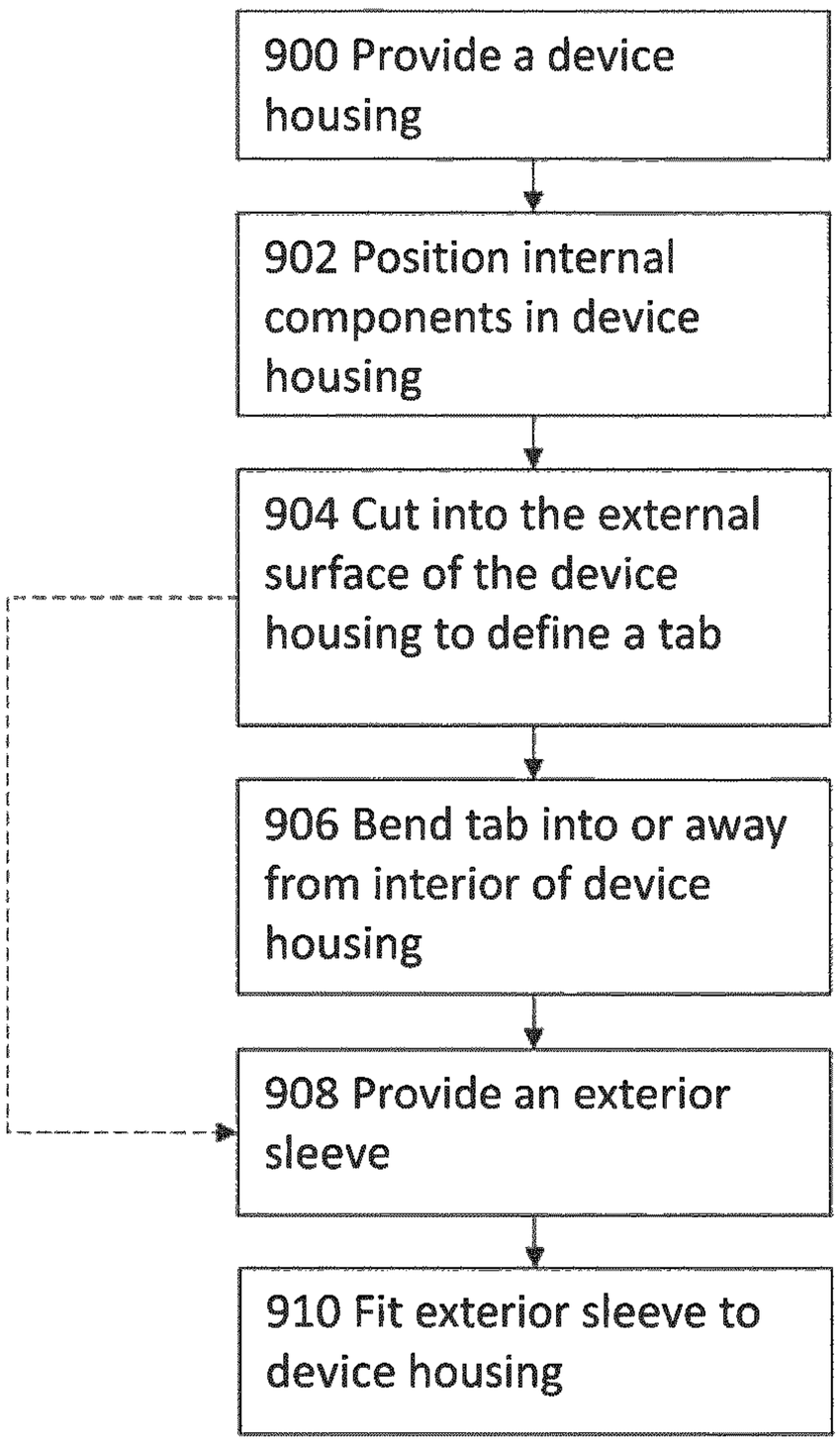

900 Provide a device housing
902 Position internal components in device housing
904 Cut into the external surface of the device housing to define a tab
906 Bend tab into or away from interior of device housing
908 Provide an exterior sleeve
910 Fit exterior sleeve to device housing

Figure 9

DEVICE ASSEMBLY METHOD AND DEVICE MANUFACTURED ACCORDING TO SUCH METHOD

This disclosure relates to aerosol-generating devices and a method of manufacturing aerosol-generating devices. In particular, this disclosure relates to aerosol-generating devices that are simple and inexpensive to manufacture and which allow for user customization.

Handheld aerosol-generating devices for heating an aerosol-forming substrate are now widespread and used as an alternative to smoking cigarettes. A handheld aerosol-generating device, such as a personal vaporiser or a "heat-not-burn" device that heats tobacco, typically comprises a plurality of internal components arranged inside a device housing. For example, WO2015/177255 discloses an inductive heating device for heating an aerosol-forming substrate. The device comprises a power source, power supply electronics and a series connection of a capacitor and an inductor all positioned within a device housing. The device housing also defines a cavity having an internal surface shaped to accommodate at least a portion of an aerosol-forming substrate to be heated by the device.

In such handheld aerosol-forming devices, the device housing is a functional component of the device but must also have a pleasing look and feel for users of the device. The housing must secure and protect the internal components from damage and support and accommodate user interface elements, such as buttons, that allow for operation of the device by a user. At the same time, the housing is desirably pleasing to look at and to hold. The look and feel of the device is largely determined by the device housing and is often a significant factor in how users perceive the overall quality of the device. Manufacturing an aerosol-generating device having a device housing that is both functionally and aesthetically acceptable can be complicated and expensive. Furthermore, once the aerosol-generating device has been manufactured, the device housing typically cannot be easily replaced.

It would be desirable to reduce the cost of manufacturing an aerosol-generating device. It would also be desirable to allow user customization of the appearance of an aerosol-generating device and to allow the user to replace the device housing if it becomes scratched or damaged during use of the aerosol-generating device.

In a first aspect, there is provided an aerosol-generating system comprising an aerosol-generating device for heating an aerosol-forming substrate, and an exterior sleeve;

the aerosol-generating device comprising:

a device housing, and

a plurality of internal components contained within an interior space enclosed by the device housing;

wherein the device housing comprises an external surface and at least one bent or bendable portion, bent or bendable into or towards the interior space to interact with one of the internal components; and

wherein the exterior sleeve is configured to removably cover the at least one bent or bendable portion.

The at least bent or bendable portion may comprise a tab defined by cuts in the external surface. Preferably, the cut extends fully through the device housing. If there is more than one bent or bendable portion there may be more than one tab. The at least one tab may interact with at least one of the internal components in order to retain that internal component. Alternatively, or in addition, the at least one tab may interact with an internal component as part of a user interface of the device, allowing a user to operate the device.

Inexpensive and simple methods of manufacture can be used to manufacture the at least one tab. Advantageously, the exterior sleeve covers the at least one tab so that the at least one tab is not visible to a user of the device. Without the at least one tab being covered, the external surface of the device housing might have an unacceptable appearance or surface finish. By covering the at least one tab with an exterior sleeve an acceptable appearance and feel can be provided.

The exterior sleeve may cover all, or at least the majority of, the device housing. The appearance of an aerosol-generating device covered by an exterior sleeve may depend on the appearance of the exterior sleeve. By providing replaceable exterior sleeves having different appearance, the aerosol-generating device can be customized. The exterior sleeve may comprise visual information, writing or other branding information. For example, the exterior sleeve may be a particular colour or combination of colours. The exterior sleeve may comprise a logo. The exterior sleeve may be opaque. An opaque exterior sleeve advantageously improve the appearance of the device when the device housing has an unacceptable appearance or surface finish.

The exterior sleeve can advantageously be removed from the aerosol-generating device and replaced. The exterior sleeve may be replaced when it has been damaged or scratched. Furthermore, the exterior sleeve may be replaced with a different exterior sleeve having a different appearance, as desired by the user. This advantageously allows the user of the aerosol-generating system to customize their aerosol-generating device after it has been manufactured or purchased. Replacement of the exterior sleeve may be performed by a user of the aerosol-generating system. Alternatively, the user may take the device to an exterior sleeve vendor to perform the replacement of the exterior sleeve.

The device housing may comprise a ductile material. For example, the device housing may comprise a metal or a thermoplastic. The device housing may comprise stainless steel. A ductile material advantageously allows the tabs to be simply formed by bending or pressing.

The aerosol-generating system may comprise a plurality of tabs formed in the external surface of the device housing, wherein at least one tab comprises a fixing element that is deflected into the interior space and engages an internal component. A fixing element formed in this way advantageously provides reliable engagement with the internal component while being inexpensive and simple to manufacture. The fixing element engaging an internal component advantageously holds the internal component in place with respect to the device housing. The engagement may be irreversible.

The fixing element may be formed by deflecting a tab into the interior space of the device housing to engage the internal component. The tab being defined by cuts may advantageously isolate the tab, reducing unwanted deflection of other regions of the external surface when the tab is deflected into the interior space. Cuts defining the tab may advantageously reduce the force required to deflect the tab into a fixing position in which it engages the internal component. The tab for forming a fixing element may be defined by cuts on at least two sides. The tab may be defined by curved cuts in the external surface. Alternatively, or in addition, the tab may be defined by straight cuts in the external surface. The tab may have two uncut ends, or fixed ends, on opposing sides. In such cases the tab for forming a fixing element may preferably be defined by cuts following a convex outer surface of the device housing. This may

advantageously allow the tab to be pressed into the interior space without requiring the tab to be stretched.

At least one tab of the external surface of the device housing may comprise a user interface element deflectable by a user toward the interior space of the device housing. A user interface element formed in this way is advantageously inexpensive and simple to manufacture.

The user interface element may be formed by bending a tab. The user interface element may be a lever. The lever may be deflectable by a user toward the interior space of the device housing. The lever may be bent away from the interior space of the device housing to provide a protruding user interface element in a neutral position. Alternatively, the lever may be flush with a surrounding portion of the device housing and deflectable inwards in operation by the user. Alternatively, the lever may be bent towards the interior space of the device housing to provide a sunken user interface element in a neutral position.

The shape and position of the cuts defining the tab for forming the user interface element may be chosen such that the lever has a desired shape and dimensions. The tab may be defined by cuts on at least two sides. The tab may be defined by curved cuts in the external surface. Alternatively, or in addition, the tab may be defined by straight cuts in the external surface. Preferably, the cuts are connected to form a continuous cut defining three sides of a tab.

An interface portion of the exterior sleeve may cover the user interface element when the exterior sleeve covers the device housing. A user of the device pressing on the interface portion may deflect the user interface element towards the interior space of the device housing.

The portion of the exterior sleeve covering the user interface element may comprise markings. These markings may be visible markings. For example, the markings may be printed onto the surface of the exterior sleeve. Alternatively or in addition, the markings may be formed by raised features on the surface of the exterior sleeve. Alternatively or in addition, the marks may be formed by depressions in the exterior sleeve.

The interface portion of the exterior sleeve may comprise a region of increased thickness relative to the rest of the exterior sleeve. This may ensure that there is contact between the exterior sleeve and the lever. This may have the advantage that less force is required by the user when pressing on the interface portion.

Alternatively or in addition, the interface portion of the exterior sleeve may be a region of increased flexibility relative to the rest of the exterior sleeve. The region of increased flexibility may be a result of indents in the exterior sleeve. Advantageously, the indents are configured to allow the portion of the exterior sleeve covering the user interface element to move relative to the rest of the sleeve.

The plurality of internal components may comprise control circuitry configured to sense deflection of the user interface element. Deflection of the user interface element may cause the control circuitry to switch on or activate the aerosol-generating device when deflection of the user interface element is detected. For example, the control circuitry may comprise a switch or a button in contact with the user interface element. Movement of the user interface element by deflection may actuate this switch or button. The control circuitry may further comprise a microprocessor, which may be a programmable microprocessor, a microcontroller, or an application specific integrated chip (ASIC) or other electronic circuitry capable of providing control. The electric circuitry may comprise further electronic components.

The plurality of internal components contained within the device housing may comprise at least one of a power supply, control circuitry, a heater assembly or a receiving portion configured to receive an aerosol-generating article comprising an aerosol-forming substrate.

The power supply may be a battery such as a lithium iron phosphate battery. As an alternative, the power supply may be another form of charge storage device such as a capacitor. The power supply may require recharging and may have a capacity that allows for the storage of enough energy for one or more user operations, for example one or more smoking experiences. The power supply may have sufficient capacity to allow for the continuous generation of aerosol for a period of around six minutes, corresponding to the typical time taken to smoke a conventional cigarette.

The heater assembly may be an inductive heating assembly. An example of an inductive heating assembly is described in WO2015/177255. The inductive heating assembly may comprise an inductor. This inductor may be in the form of a coil or a plurality of coils. The plurality of coils may form a helix. The inductor may be in electrical communication with a power supply. The supply of power from the power supply to the inductor may be controlled by the control circuitry. The control circuitry may use the sensed deflection of a user interface element to begin a heating cycle (i.e. begin supplying power to the inductor). The control circuitry may control the supply of power in accordance with a pre-determined heating profile stored in the control circuitry. The power supply may be a DC power supply and the control circuitry may comprise a DC/AC inverter connected to the DC power source. The DC/AC inverter may comprise a Class-D or Class-E power amplifier. The power supply may comprise power supply electronics configured to operate at high frequency. For the purpose of this application, the term "high frequency" is to be understood to denote a frequency from 1 MHz to 30 MHz, preferably a frequency from 1 MHz to 10 MHz, and even more preferably a frequency from 5 MHz to 7 MHz.

The inductor may be configured to heat a conductive susceptor element in the vicinity of the inductor. The susceptor element may be a conductive element that heats up when subjected to a changing magnetic field. This changing magnetic field may be created in the inductor as a result of high frequency power supply in connection with the inductor. The heating up of the susceptor may be the result of at least one of eddy currents induced in the susceptor element and hysteresis losses. Possible materials for the susceptor elements include graphite, molybdenum, silicon carbide, stainless steels, niobium, aluminium and virtually any other conductive elements. In use, the changing electromagnetic field generated by the inductor heats the susceptor element which then transfers the heat to the aerosol-forming substrate of the aerosol-forming article, mainly by conduction. The susceptor element may be configured to heat the aerosol-forming substrate by at least one of conductive heat transfer, convective heat transfer, radiative heat transfer, and combinations thereof. For this, the susceptor is in thermal proximity to the material of the aerosol forming substrate.

Preferably, the susceptor element does not form part of the aerosol-generating device. Instead, the susceptor is contained within aerosol-generating articles for use with the aerosol-generating device. The susceptor may be in thermal proximity to the aerosol-forming substrate of the aerosol-generating article.

Advantageously, the susceptor element has a relative permeability between 1 and 40000. When a reliance on eddy currents for a majority of the heating is desirable, a lower

permeability material may be used, and when hysteresis effects are desired then a higher permeability material may be used. Preferably, the material has a relative permeability between 500 and 40000. This provides for efficient heating.

The material of the susceptor element may be chosen because of its Curie temperature. Above its Curie temperature a material is no longer ferromagnetic and so heating due to hysteresis losses no longer occurs. The Curie temperature may correspond to a maximum temperature the susceptor element should have (that is to say the Curie temperature is identical with the maximum temperature to which the susceptor element should be heated or deviates from this maximum temperature by about 1-3%). This reduces the possibility of rapid overheating.

The plurality of internal components may further comprise a receiving portion configured to receive an aerosol-generating article comprising an aerosol-forming substrate. The heating assembly may be positioned to heat the aerosol-generating article when the aerosol-generating article is received in the receiving portion. The inductor coil of the heating assembly may be positioned in the receiving portion. This has the advantage that the inductor surrounds an aerosol-generating article received in the receiving portion. This is particularly advantageous when the susceptor element is contained within the aerosol-generating article as it ensures a close proximity between the inductor coil of the aerosol-generating device and the susceptor element of the aerosol-generating article.

The device housing may comprise metal. The device housing may be formed from a single piece of material. This simplifies manufacture as there is no need for joints or connections between multiple pieces of housing. Any fixing elements or user interface elements, such as buttons, may be formed in the single piece of material of device housing. This again simplifies manufacture as there is no need for joints or connections between multiple pieces of housing. The device housing may be substantially tubular. The device housing may be substantially cylindrical.

The exterior sleeve may be particularly suitable for devices having a single piece device housing. In particular, the exterior sleeve may be suited to devices that do not comprise any elements that penetrate the aerosol-forming substrate. In devices that include a penetrating element, such as a heater, that penetrates the aerosol-forming substrate, a slidable portion of the device housing is typically provided to aid extraction of the aerosol-forming substrate from the penetrating element after use. Devices that use inductive heating typically do not include any penetrating elements. The exterior sleeve may be particularly suited to devices that use inductive heating.

The internal components may further comprise a flux concentrator. The flux concentrator may distort fluctuating magnetic field generated by the inductor coil towards the centre of the receiving portion (i.e. towards the aerosol-forming article received in the receiving portion). This advantageously concentrates the magnetic field within the receiving portion and so increases the level of heat generation in the susceptor for a given level of power passing through the inductor coil. The flux concentrator may also comprise an electromagnetic shield which may be positioned to prevent magnetic field from escaping an inductor. If the inductor is in the shape of a coil, the flux concentrator may have an annular shape. The flux concentrator may then be positioned to surround the inductor coil.

The exterior sleeve may comprise silicone. Silicone is advantageously both durable and flexible. Silicone also has elastic properties. An exterior sleeve comprising silicone may advantageously be inexpensive to manufacture while being easy to mould into a desired shape having a desired appearance. Features may be moulded into an exterior sleeve comprising silicone.

The exterior sleeve may comprise a plurality of separate parts connected together. An exterior sleeve comprising a plurality of parts may advantageously be easier to fit to, or remove from, the aerosol-generating device. If the exterior sleeve has a portion covering the user interface element this may be formed in only one of the plurality of separate parts. The parts may have a very similar appearance (i.e. for example, each part may comprise the same visual information, writing or branding). Alternatively, one part may have a different to appearance to another. The plurality of parts of the exterior sleeve may be connected by a snap-fit connection.

As used herein, the term "snap-fit connection" means a connection comprising one male part and one female part. The male part may be formed in a first part of the exterior sleeve and the female part formed in a second part of the exterior sleeve. In a stress-free state, the male and female part may not fit together. However, the exterior sleeve may have elastic properties and so when a force is applied one, or both of the male and female parts may bend, allowing the first and second parts to be fitted together. After the joining operation, the male and female parts may return to a stress-free state. Snap-fit connections advantageously allow for removable, yet resilient, connection between the first and second parts of the exterior sleeve. The female part may be a groove formed in the first part of the exterior sleeve. The male part may be a lip or rib formed in the second part of the exterior sleeve.

As used herein, the term "aerosol-generating substrate" relates to a substrate capable of releasing volatile compounds that can form an aerosol. Such volatile compounds may be released by heating the aerosol-forming substrate. An aerosol-forming substrate may conveniently be part of an aerosol-forming article.

As used herein, the term "aerosol-generating article" refers to an article comprising an aerosol-forming substrate that is capable of releasing volatile compounds that can form an aerosol. For, example, an aerosol-generating article may be an article that generates an aerosol that is directly inhalable by the user drawing or puffing on a mouthpiece at a proximal or user-end of the system. An aerosol-generating article may be disposable. An article comprising an aerosol-forming substrate comprising tobacco is referred to as a tobacco stick.

As used herein, the term "aerosol-generating device" refers to a device that interacts with an aerosol-generating article to generate an aerosol. The aerosol-generating device may be reusable.

As used herein, the term "exterior sleeve" refers to a sleeve that is configured to fit over an aerosol-generating device.

As used herein, the term "aerosol-generating system" refers to the combination of an aerosol-generating article, an aerosol-generating device and an exterior sleeve.

Preferably, the aerosol-forming substrate comprises a tobacco-containing material including volatile tobacco flavour compounds which are released from the aerosol-forming substrate upon heating. Alternatively, the aerosol-forming substrate may comprise a non-tobacco material. The aerosol-forming substrate may comprise an aerosol former that facilitates the formation of a dense and stable aerosol. As used here, the term "aerosol former" is used to describe any suitable known compound or mixture of compounds

that, in use, facilitates formation of an aerosol. Suitable aerosol formers are substantially resistant to thermal degradation at the operating temperature of the aerosol-generating article. Examples of suitable aerosol formers are glycerine and propylene glycol.

The aerosol-forming substrate may be a solid aerosol-forming substrate. Alternatively, the aerosol-forming substrate may comprise both solid and liquid components. In a particularly preferred embodiment, the aerosol-forming substrate comprises a gathered crimped sheet of homogenised tobacco material. As used here, the term "crimped sheet" denotes a sheet having a plurality of substantially parallel ridges or corrugations.

In a second aspect of the invention, there is provided a kit comprising an aerosol-generating device for heating an aerosol-forming substrate and at least one exterior sleeve:

the aerosol-generating device comprising:

a device housing, and

a plurality of internal components contained within an interior space enclosed by the device housing;

wherein the device housing is formed from a single piece of material and comprises an external surface and at least bent or bendable portion, bent or bendable into or towards the interior space to interact with one of the internal components; and

wherein the at least one exterior sleeve is configured to removably cover the at least one bent or bendable portion.

The at least one bent or bendable portion may comprise a tab defined by cuts in the external surface.

The kit may comprise a first exterior sleeve and a second exterior sleeve, wherein the first exterior sleeve comprises an external surface comprising visual information, writing or other branding information and the second exterior sleeve comprises an external surface comprising visual information, writing or other branding information different to the visual information, writing or other branding information of the external surface of the first exterior sleeve. This advantageously allows the user to customize the aerosol-generating device. For example, the user may have a preference as to the appearance of the first or second exterior sleeve and can fit whichever they prefer to the aerosol-generating device. This may be done at home or with the help of an expert who performs the fitting on the behalf of the user.

In a third aspect of the invention, there is provided method of manufacturing an aerosol-generating system comprising the steps of:

providing a device housing for containing a plurality of internal components within an interior space and wherein the device housing comprises an external surface;

providing at least one bent or bendable portion in the device housing that is bent or is bendable towards the interior space to interact with one of the internal components; and

providing an exterior sleeve configured to removably cover the at least one bent or bendable portion.

The method of manufacturing an aerosol-generating system may further comprise the step of deflecting the at least one bent or bendable portion into the interior space to interact with one of the components and fitting the exterior sleeve onto the device housing.

The method of manufacturing an aerosol-generating system may further comprise the step of cutting the external surface of the device housing to define at least one tab as the at least one bent or bendable portion, wherein the tab is deflectable towards the interior space to interact with one of the internal components. Features described in relation to one aspect may be applied to other aspects of the disclosure. In particular, advantageous or optional features described in relation to the first aspect of the disclosure may be applied to the second and third aspects of the invention.

Embodiments of an aerosol-generating system and method of manufacturing the aerosol-generating system will now be described in detail, by way of example only and with reference to the accompanying drawings, in which:

FIG. **1** is a perspective view of an aerosol-generating system comprising an aerosol-generating device and an exterior sleeve.

FIG. **2** is a perspective view of a kit comprising the aerosol-generating device of FIG. **1** and first and second exterior sleeves, the first sleeve comprising different visual information, writing or branding to the second sleeve.

FIG. **3** is a cross-sectional schematic of the aerosol-generating device of FIG. **1** in which an aerosol-generating article is received.

FIG. **4** is an exploded perspective view of the aerosol-generating device of FIG. **1**, showing the internal components that are contained by the device housing.

FIG. **5** shows four embodiments of cuts in the device housing of the aerosol-generating device of FIG. **1**, where each embodiment is shown as a plan schematic of the device housing from above.

FIG. **6** is a cross-sectional schematic showing three different embodiments of the external sleeve of FIG. **1** covering the aerosol-generating device of FIG. **1**. Each embodiments is shown as a close-up cross-sectional schematic.

FIG. **7** is a perspective view of an embodiment of the exterior sleeve of FIG. **1** comprising two connected parts.

FIG. **8** is a close-up schematic view of the connection between two connected parts of exterior sleeve of the exterior sleeve shown in FIG. **8**.

FIG. **9** is a flow diagram representing a method of manufacturing the aerosol-generating system shown in FIG. **1**.

FIG. **1** shows a perspective view of an aerosol-generating system **10** comprising an aerosol-generating device **100** and an exterior sleeve **120**. The aerosol-generating device **100** is configured for heating an aerosol-forming article comprising an aerosol-forming substrate. The aerosol-generating device **100** comprises a device housing **102** and a plurality of internal components, not visible in FIG. **1**. The device housing **102** has an external surface **103** and encloses an interior space **104**. The plurality of internal components are contained within internal space **104**. The device housing **102** is tubular and is formed from a single piece of metal. A plurality of bendable portions are formed in the external surface **103** of the device housing **102** which are bent or bendable into or towards the interior space **104** to interact with one of the internal components. Each bendable portion comprises a tab **106**, **107** and **108** defined by cuts in the external surface **103** of the device housing **102**. Each tab **106**, **107** and **108** interacts with one of the internal components.

Tabs **106** and **107** are fixing elements. Each fixing element is formed by cutting through the external surface **103** to define a tab and then deflecting that tab toward the interior space **104**. The fixing elements **106**, **107** interact with internal components by engaging the internal components. This engagement holds the respective internal components in place with respect to the device housing **102**.

Tab **108** is a user interface element in the form of a lever. The lever **108** is formed by cutting into the device housing **102** to form a tab and bending that tab towards the interior

space of the device housing such that it enters the interior space of the device housing. The lever **108** is deflectable further into the interior space of the device housing when operated by a user. The lever interacts with an internal component when it is deflected.

Device housing **102** securely houses the internal components, protecting them from damage as well as supporting any further user interface elements, such as LEDs. Forming the tabs in the external surface **103** by cutting and then deflecting or bending the tabs is inexpensive and simple. Device housing **102** is functionally operable without the requirement for any exterior sleeve. However, the device housing **102** having cut out tabs is not pleasing to look at or to hold.

By providing an exterior sleeve **120** on the aerosol-generating device **100**, the aerosol-generating device can be made aesthetically acceptable. In the embodiment shown in FIG. **1**, the exterior sleeve **120** is configured to removably cover the entire external surface **103** of the device housing. However, this may not be required. The aerosol-generating device **100** may be aesthetically acceptable if the exterior sleeve **120** covers enough of the external surface **103** that any tabs are covered. Some portions of device housing **102** may have an acceptable look and feel.

The exterior sleeve **120** is made of silicone, which is both durable and flexible, and is moulded to match the shape of the aerosol-generating device **100** such that when the exterior sleeve is fitted there is a close fit between sleeve and device, and the exterior sleeve does not easily move relative to the device housing. The exterior sleeve is held in place by friction between the exterior sleeve and the device housing.

The exterior sleeve **120** comprises interface portion **122**. When the exterior sleeve **120** covers the aerosol-generating device **100**, the interface portion **122** covers lever **108**. A user of the device pressing on the interface portion **122** deflects the lever **108** towards the interior space **104** of the device housing **102**. The interface portion **122** is defined by a raised ring **124** formed in the surface of the exterior sleeve **120**. The raised ring **124** is an indicator to a user of the device as to the location of the lever **108**, covered by the exterior sleeve **120**.

As described above, using the exterior sleeve **120** to cover the aerosol-generating device **100** results in the aerosol-generating device **100** having an acceptable look and feel. The appearance of the aerosol-generating device **100** depends on the appearance of the exterior sleeve **120**. Customized exterior sleeves **120** with a particular appearance may be provided. By removing and replacing a first exterior sleeve with a second exterior sleeve the appearance of the aerosol-generating device **100** can be changed, thus allowing for continued customization of the aerosol-generating device. This is exemplified in FIG. **2**.

FIG. **2** is a perspective view of a kit comprising an aerosol-generating device **100**, as described in relation to FIG. **1**, and first and second exterior sleeves **202**, **212**. The first and second exterior sleeves **202**, **212** are identical to one another, and to exterior sleeve **120** described above, apart from having a different appearance. Exterior sleeve **202** comprises a first logo **204** and is a single colour. Exterior sleeve **212** comprises a second logo **214** and has a striped pattern consisting of two, different, alternating colours. Therefore, exterior sleeve **202** has a different appearance to exterior sleeve **212**. Covering the aerosol-generating device **100** with exterior sleeve **212** instead of exterior sleeve **202** (or vice versa) will alter the appearance of the aerosol-generating device **100**. This allows for customization of the aerosol-generating device **100**.

It should be understood that the exterior sleeves **202** and **212** shown in FIG. **2** are exemplary. Exterior sleeves may comprise any visual information, writing or other branding so as to give the aerosol-generating device a desired appearance. Furthermore, it should be clear that the first and second logo **204** and **214** are merely placeholders demonstrating that different sleeves may comprise different branding and do not represent actual branding to be included on exterior sleeves.

FIG. **3** is a cross-sectional schematic of the aerosol-generating device **100**, in which an aerosol-generating article **302** is received. FIG. **3** shows a plurality of internal components contained within device housing **102**.

The aerosol-generating device **100** comprises a receiving portion **304**. The receiving portion **304** comprises an opening **310** through which the aerosol-generating article **302** may be inserted and removed. The receiving portion also comprises a heating assembly comprising inductor coil **312**. The inductor coil **312** is a helical inductor coil having a magnetic axis corresponding to the longitudinal axis of the receiving portion **304**, see dotted line of FIG. **3**. The aerosol-generating device **100** also comprises power supply **306**, for example a rechargeable battery, and control circuitry **308**, for example a printed circuit board with circuitry. The control circuitry **308** and the inductor coil **312** both receive power from the power supply **306**.

The aerosol-forming article **302** comprises aerosol-generating substrate and a conductive susceptor element **303** arranged within the aerosol-generating article **302** such that it is inductively heatable by the inductor coil **312** when the aerosol-forming article **302** is received in the receiving portion **304**. The aerosol-forming substrate is a tobacco-containing material including volatile tobacco flavour compounds which are released from the aerosol-forming substrate upon heating. The aerosol-forming substrate also comprises an aerosol former such as glycerine or propylene glycol that facilitates the formation of a dense and stable aerosol.

The operation of the aerosol-generating device **100** is controlled by control circuitry **308**. This includes initiating a heating cycle whereby the control circuitry **308** controls the supply of power to the inductor coil **312** in accordance with a pre-determined heating profile stored in the control circuitry **308**.

The control circuitry **308** comprises a DC/AC inverter connected to the power source **306**, which is a DC power source. The DC/AC inverter includes a Class-E power amplifier including a transistor switch, a transistor switch driver circuit, and an LC load network. Class-E power amplifiers are generally known and are described in detail, for example, in the article "Class-E RF Power Amplifiers", Nathan O. Sokal, published in the bimonthly magazine QEX, edition January/February 2001, pages 9-20, of the American Radio Relay League (ARRL), Newington, CT, U.S.A. Therefore, a high frequency current can be supplied to the inductor coil **312**. A changing magnetic field is created by the inductor as a result the high frequency current. This induces changing currents in the conductive susceptor element **303**, resulting in the heating up of the susceptor element **303**. The heated susceptor element **303** heats the aerosol-forming substrate of the aerosol-generating article **302** to a sufficient temperature to form an aerosol. The aerosol can then be drawn downstream through the aerosol-generating article **302** for inhalation by the user of the device.

The receiving portion **304** further comprise a flux concentrator comprising an electromagnetic shield (not shown

in FIG. **3**) which surrounds the inductor coil **312**. The flux concentrator distorts the fluctuating magnetic field generated by the inductor coil **312** towards the centre of the receiving portion **304** (i.e. towards the aerosol-forming article **302** received in the receiving portion **304**). This concentrates the magnetic field within the receiving portion **304** and so increases the level of heat generating in the susceptor element **303** for a given level of power passing through the inductor coil **312**. The flux concentrator is tubular and surrounds the inductor coil, extending along its longitudinal axis. The flux concentrator is made from ferrite. The electromagnetic shield reduces undesired heating of adjacent conductive parts of the device, for example the metallic device housing, or of adjacent conductive items external to the aerosol-generating device **100**. Focusing the magnetic field of the inductor coil **312** and reducing undesired heating and losses increases the efficiency of the aerosol-generating device **100**.

FIG. **4** is an exploded perspective view of the aerosol-generating device **100**, showing the plurality internal components and the device housing **102** with external surface **103**. A main frame **402** hosts the power supply **306** and control circuitry **308**. The receiving portion **304** is an assembly of a coil former **404**, a flux concentrator **406** (as described above) and an encapsulation sleeve **408** with each fitting sequentially into the other. The encapsulation sleeve is a protective outer layer for holding the flux concentrator in place. The coil former **404** comprises the inductor coil **312**. Coil former **404** defines an opening **310** in which the aerosol-generating article **302** is received. When the aerosol-generating device **100** is assembled, the main frame **402** is inserted into the interior space **104** of device housing **102**, followed by the assembled receiving portion **304** which abuts the main frame **402**. End pieces **410** are pushed into the device housing **102** at either end.

The lever **108**, formed in the device housing **102**, is in contact with the control circuitry **308** when the main frame **402** is inserted into the device housing **102**. Deflection of lever **108** is detected by the control circuitry **308**. The control circuitry then initiates the heating cycle described previously.

Fixing means **106** is in contact with the power supply **306** and fixing means **107** is in contact with the receiving portion **304**. This prevents movement of the internal components with respect to the device housing.

FIG. **5** is a plan schematic of a portion of the device housing **102**, showing embodiments of cuts in the device housing **102** defining regions which can form tabs. Cuts are shown by dotted lines **502**. The region defined by the cuts **502** in each embodiment has a different shape. It would be well understood by the skilled person that the tabs formed by from these regions will have different shapes.

FIG. **5**(*a*) shows an embodiment where cuts **502** define a region **504** in the device housing on three sides. The fourth side of region **504** is not cut. One end of region **504** is surrounded by cuts, and will be referred to herein as the free end. The other end is not cut, and will be referred to herein as the fixed end.

A fixing element is formed when region **504** is deflected towards the interior space of the device housing such that the free end will be lower than the fixed end and the free end interacts with internal component to hold it in place.

A user interface element is formed because region **504** is deflectable into the interior space **104** of the device housing **102**. In some embodiments, the user interface element is bent into or away from the interior space of the device housing in a neutral position. However, this is not required. The user interface element is a lever and so the closer to the free end that the user presses, the lower the force that is required to deflect the lever.

FIGS. **5**(*b*) and **5**(*c*) show similar embodiments where region **506** and **508** has a free end, defined by cuts on all sides, and a fixed end. The cuts in the different embodiments have different shapes and so the region defined by the cuts has a different shape.

The embodiment shown in FIG. **5**(*d*) differs from the embodiments of FIGS. **5**(*a*) to (*c*) in that it is formed from two parallel cuts, adjacent to one another and of substantially equal length. The region **510** defined between these two cuts does not have a free end, rather it has two fixed ends.

The tab of FIG. **5**(*d*) has an axis defined from a first fixed end to a second fixed end. The tab axis preferably follows a convex outer surface of the device housing. This allows the tab to be pressed into the interior space without requiring the tab to be stretched.

A fixing element is formed when region **510** is deflected towards the interior space **104** of the device housing **102**. The central portion of the region **510** interacts with the internal component.

Referring back to FIG. **3**, the aerosol-generating device comprises a plurality of fixing elements **106**, **107**, **336**, **337** formed from cuts in the device housing and interacting with internal components. The aerosol-generating device also comprises lever **108** interacting with the control circuitry **308**.

The fixing elements **106**, **107**, **336**, **337** are formed from cuts in the device housing **102** as shown in FIG. **5**(*d*). Fixing elements **106** and **336** are deflected to interact with the power supply **306**. Fixing elements **107** and **337** are deflected to interact with the receiving portion **304**. The interaction with the power supply **306** and receiving portion **304** is that the fixing elements are deflected to be in frictional contact and so hold the power supply and receiving portion in place with respect to the device housing. In the embodiment shown in FIG. **3** the fixing elements are deflected into grooves in the respective components. This improves the reliability of the fixing elements to hold the components in place but is not a required feature. Frictional contact between fixing element and internal component is enough. Furthermore, in the embodiment shown in FIG. **3**, the power source **306** and receiving portion **304** are each held in place by two fixing means on opposite sides of each component. Again, this is not a required feature. There may be any number of fixing means in contact with any number of internal components, depending on the particular design of the aerosol-generating device.

Lever **108** is formed from cuts in the device housing **102** according to the embodiment shown in FIG. **5**(*a*). Lever **108** has been bent towards the interior space of the device housing **102** such that it is in close proximity to switch **340**, which forms part of control circuitry **308**. Lever **108** is deflectable. Deflection of lever **108** can be sensed by switch **340**. When deflection is sensed the control circuitry **308** is configured to initiate operation of the aerosol-generating device. For example, by initiating a heating cycle whereby the control circuitry **308** controls the supply of power to the inductor **312** in accordance with a pre-determined heating profile stored in the control circuitry **308**.

The embodiment shown in FIG. **3** comprises both fixing elements and user interface elements. However, an aerosol-generating device may comprise only fixing elements or user interface elements. For example, the aerosol-generating device may comprise a puff sensor in the form of a micro-

phone. In such an embodiment a user interface element may not be required as the operation of the device may be initiated when the microphone detects air-flow through the device as a result of a user puffing on an aerosol-generating article **302** received in the aerosol-generating device **100**. In such an embodiment there may be at least one fixing element and no user interface element. In another embodiment the plurality of internal components need only be held in place at either end of the device housing **102** by end pieces **410** inserted into the aerosol-generating device **100**. Therefore, there may be no need for fixing elements formed by tabs.

The contact between the exterior sleeve **120** and the lever **108**, and particularly the interface portion **122** and the lever **108**, is show in FIG. **6**. FIG. **6** shows three different embodiments of a portion of the exterior sleeve **120** covering lever **108** as close-up cross-sections.

FIG. **6**(*a*) shows a first embodiment of interface portion **122**. In this embodiment the interface portion **122** is defined by markings in the form of a raised feature in the surface of the exterior sleeve. The raised feature is a raised ring **124** in the surface of the exterior sleeve **120**. The raised ring **124** acts as an indicator to a user of the device as to the location of the lever **108**. When the user pushes down on the interface portion **122**, the exterior sleeve, which is made of flexible silicone, will bend toward the lever **108**. Once in contact with the lever **108** the lever **108** will be deflected towards the interior space **104** of the of aerosol-generating device **100**.

FIG. **6**(*b*) shows a second embodiment of interface portion **122**. In this embodiment the interface portion of the exterior sleeve **120** comprises a region of increased thickness **602** relative to the rest of the exterior sleeve **120**. As shown in FIG. **6**(*b*), the increased thickness **602** is on the side of the exterior sleeve **120** in contact with lever **108**. This reduces the distance that the interface portion **122** is required to move before deflecting the lever **108** and so less force is required by the user when pressing on the interface portion **122** to deflect the lever **108**.

FIG. **6**(*c*) shows a third embodiment of interface portion **122**. In this embodiment the interface portion **122** is defined by an indent **604** in the exterior sleeve. The indent **604** has a ring shape. The indent **604** is a region of reduced thickness relative to the rest of the exterior sleeve **120**, and so has increased flexibility relative to the rest of the exterior sleeve **120**. This reduces the amount of force required to bend the exterior sleeve **120** such that interface portion **122** deflects lever **108**. In the embodiment shown in FIG. **6**(*c*) the indent **604** is on both sides of the exterior sleeve. However, it should be understood that the indent **604** may be on only one side.

The features of FIG. **6**(*a*) to (*c*) can be combined. For example, the embodiment shown in FIG. **6**(*b*) may also comprise the raised ring **124** shown in FIG. **6**(*a*) or the indent **604** shown in FIG. **6**(*c*).

FIG. **7** is a perspective view of an embodiment of exterior sleeve **120** comprising a first part **702** and a second part **704** connected together at connection **706**. The interface portion **122** forms part of the first part **702**. The connection **706** is shown as a close up cross-section in FIG. **8**. Connection **706** is a snap-fit connection. The first part **702** is a female part, comprising groove **802**. The second part **704** is a male part, comprising lip or rib **804**. In a stress-free state, the lip **804** and groove **802** do not fit together. However, the exterior sleeve **120** has elastic properties and so the when a force is applied, one or both of the lip **804** and groove **802** is bent, allowing the first and second parts to be fitted together. After the joining operation, the lip **804** and groove **802** return to a stress-free state, forming a removable, yet resilient, connection.

FIG. **9** is a flow diagram representing a method of manufacturing the aerosol-generating system shown in FIG. **1**.

First, in step **900** a device housing **102** is provided. As previously described, the device housing **102** is tubular and encloses an interior space. The device housing **102** is made of metal.

In step **902** a plurality of internal components are positioned in the internal space **104** of the device housing **102**. Prior to this step the internal components need to be assembled. The power supply **306** and control circuitry **308** are both hosted on main frame **402**. The receiving portion **312** is assembled from a coil former **404**, inserted into a flux concentrator **406** which is then inserted into an encapsulation tube **408**. The assembled receiving portion **312** abuts the main frame **402** and is mechanically engaged to the main frame **402**. This mechanical engagement comprises electrical connections such that the power supply **306** and control circuitry **308** of the main frame **402** are in electrical communication with receiving portion **412**.

In step **904** cuts are made in the external surface **103** of the device housing by pressing a cutting tool into the external surface **103** with enough force to cut through the external surface **103** of the device housing **102**. The cuts in the device housing define a tab which is a bent or bendable portion of the exterior housing. Any number of tabs may be defined by cutting into the external surface **103**. The tabs may be defined simultaneously or sequentially, depending on the cutting tool used.

In some embodiments of the manufacturing method the plurality of internal components may be positioned in the internal space of the device housing **102** after the cuts are made in the external surface **103** of the device housing **102**. In such embodiments step **902** will occur after step **904**.

In step **906** a tab is bent or deflected into or away from the interior of the device housing using a pressing tool. If more than one tab is defined in step **904**, then any number of these tabs may be bent or deflected. A fixing element is formed when a tab is deflected towards the interior space of the device housing using a press, until it engages an internal component positioned within the device housing **102**. A user interface element is formed when a tab is bent toward the internal space **104** of the device housing using a press die tool until it is in close proximity with an internal component positioned within the device housing will form a user interface element. Lever **108** is an example of such user interface element formed in this way. Alternatively or additionally, a user interface element can be formed by bending a tab away from the interior of the device housing.

Step **906** of the manufacturing process is optional. Bending or deflecting the tabs defined in step **904** is not required for some user interface elements. A user interface element may be a tab that is deflectable towards the interior space. The tab is deflectable once it has been cut. It is not a requirement that a tab is bent in order for it to form a user interface element. For such a user interface element, step **906** is not performed and the manufacturing process jumps straight from step **904** to **908**. This is shown by the dotted arrow of FIG. **9**.

In step **908** an exterior sleeve **120** is provided. The exterior sleeve **120** is moulded from silicone. In embodiments where the aerosol-generating device **100** comprises a user interface element, the moulded exterior sleeve comprises an interface region **122**. This interface region **122** is

moulded into the exterior sleeve. The exterior sleeve **120** is fitted to the device housing to cover the tabs cut into the device housing **100**. In some embodiments, either or both of steps **908** and **910** form part of a process that is separate to the process outlined in steps **900** to **906**. For example, the fitting of the exterior sleeve **120** to the device housing may be performed by a user of the device after purchasing the device and the exterior sleeve **120** separately. The fitting may require a specialised tool. In these cases, a user of the device may take the exterior sleeve **120** and the device to a vendor who will fit or remove the exterior sleeve using the specialised tool.

The exterior sleeve **120** comprises visual information, writing or branding. Some of this is included at the time of moulding the exterior sleeve **120**. For example, silicone having a particular colour is used to mould the exterior sleeve. Typically, however, features such as writing and branding must be included in post-processing of the exterior sleeve. Such methods of post-processing are well-known in the art and include, for example, printing.

In some embodiments the exterior sleeve **120** is moulded as a single piece. However, in other embodiments the exterior sleeve **120** comprises two pieces and the pieces are connectable using a snap-fit connection. In such cases, the pieces comprise reciprocal grooves which are formed at the time of moulding the exterior sleeve **120**.

The invention claimed is:

1. An aerosol-generating system, comprising:
an aerosol-generating device configured to heat an aerosol-forming substrate; and
an exterior sleeve,
wherein the aerosol-generating device comprises:
a device housing, and
a plurality of internal components contained within an interior space enclosed by the device housing,
wherein the device housing comprises an external surface and at least one bent or bendable portion, bent or bendable into or towards the interior space to interact with one of the internal components, and
wherein the exterior sleeve covers the at least one bent or bendable portion.

2. The aerosol-generating system according to claim **1**, wherein the at least one bent or bendable portion comprises a bent portion comprising a tab defined by cuts in the external surface.

3. The aerosol-generating system according to claim **2**, further comprising a plurality of tabs formed in the external surface of the device housing,
wherein at least one tab forms a fixing element that is deflected into the interior space and engages an internal component to hold the internal component in place with respect to the device housing.

4. The aerosol-generating system according to claim **2**, wherein at least one tab of the external surface of the device housing comprises a user interface element deflectable toward the interior space of the device housing.

5. The aerosol-generating system according to claim **4**, wherein the exterior sleeve is configured such that the portion of the exterior sleeve covering the user interface element when the exterior sleeve covers the device housing is configured such that haptic input from a user of the aerosol-generating device on that portion will cause the user interface element to deflect towards the interior space of the device housing.

6. The aerosol-generating system according to claim **4**, wherein the plurality of internal components comprises control circuitry configured to sense movement of the user interface element.

7. The aerosol-generating system according to claim **1**, wherein the plurality of internal components contained within the device housing comprises at least one of a power supply, control circuitry, a heater assembly, or a receiving portion configured to receive an aerosol-generating article comprising the aerosol-forming substrate.

8. The aerosol-generating system according to claim **7**,
wherein the plurality of internal components comprises a heater assembly, and
wherein the heater assembly is an inductive heating assembly.

9. The aerosol-generating system according to claim **7**,
wherein the plurality of internal components comprises a heating assembly and a receiving portion, and
wherein the heating assembly is positioned to heat the aerosol-generating article when the aerosol-generating article is received in the receiving portion.

10. The aerosol-generating system according to claim **1**, wherein the device housing is formed from a single piece of material.

11. The aerosol-generating system according to claim **1**, wherein the exterior sleeve comprises a plurality of separate parts connected together.

12. A kit, comprising:
an aerosol-generating device configured to heat an aerosol-forming substrate; and
at least one exterior sleeve,
wherein the aerosol-generating device comprises:
a device housing, and
a plurality of internal components contained within an interior space enclosed by the device housing;
wherein the device housing is formed from a single piece of material and comprises an external surface and at least one bent or bendable portion, bent or bendable into or towards the interior space to interact with one of the internal components, and
wherein the at least one exterior sleeve is configured to removably cover the least one bent or bendable portion.

13. The kit according to claim **12**, further comprising:
a first exterior sleeve and a second exterior sleeve,
wherein the first exterior sleeve comprises an external surface comprising visual information, writing, or other branding information, and
wherein the second exterior sleeve comprises an external surface comprising visual information, writing, or other branding information that is different from the visual information, writing, or other branding information of the external surface of the first exterior sleeve.

14. A method of manufacturing an aerosol-generating system, comprising steps of:
providing a device housing for containing a plurality of internal components within an interior space, the device housing comprising an external surface;
providing at least one bent or bendable portion in the device housing that is bent or bendable towards the interior space to interact with one of the internal components; and
providing an exterior sleeve to removably cover the at least one bent or bendable portion.

15. The method of manufacturing an aerosol-generating system according to claim **14**, further comprising the step of:
fitting the exterior sleeve onto the device housing,

wherein the step of providing at least one bent or bendable portion comprises:

cutting an external surface of the device housing to define a tab, and

deflecting the tab into the interior space to engage an internal component to hold the internal component in place with respect to the device housing to form a fixing element.

* * * * *